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J. R. HIND, Esq., F.R.S., President, in the Chair.

Harry Escombe, Esq., Durban, Natal;
Major Edward Smith Gordon, R A., Royal Arsenal, Woolwich;
Thomas Hands, Esq., B.A., 19 Castle Street, Carlisle;
Jasper Nicolls Harrison, Esq., Saling Grove, Braintree, Essex;
Alfred Morris, Esq., Sydney, New South Wales;
Samuel Hickling Parkes, Esq., King's Norton, Worcestershire;
George Elliot Ranken, Esq., B.A., 4 Philbeach Gardens, South Kensington;
Isaac Roberts, Esq., Kennessee, Maghull, near Liverpool;
Captain Moultrie Salt, 48 Clifton Hill, St. John's Wood, N.W.;
Rev. William Joseph Wilby, B.A., H.M.S. "Champion," Pacific Station;

were balloted for and duly elected Fellows of the Society.

Remarques sur la méthode proposée par M. le professeur Pritchard pour la mesure de l'éclat des astres. (*Exposé d'un autre procédé pour atteindre le même but.*) Par M. Loewy, membre de l'Institut.

Depuis plusieurs années, nous avons entrepris, MM. Paul et Prosper Henry et moi, une série de recherches ayant pour but la construction d'un appareil destiné à mesurer avec facilité et précision l'éclat des astres. Parmi les procédés que nous avons

expérimentés se trouve celui dont s'est servi M. le professeur Pritchard; comme lui nous avons employé pour éteindre la lumière des étoiles un verre prismatique achromatisé.

Nous avons dû abandonner ce procédé après avoir constaté qu'il offrait des inconvénients sérieux, surtout quand il s'agit d'affaiblir la lumière dans une proportion considérable, en agissant par exemple sur 7 or 8 grandeurs d'étoiles. En effet, nous avons étudié par des procédés physiques la nature de la lumière après son passage à travers le verre neutre. Pour effectuer ces expériences, nous avons recueilli, en France, en Angleterre, et en Allemagne une cinquantaine d'échantillons, les meilleurs que nous ayons pu nous procurer; mais nous avons toujours constaté une coloration très notable dans les images affaiblies, même pour les lames prismatiques les plus pures et qui à la vue semblaient n'accuser aucune différence de teinte. De telle sorte qu'aucun des verres examinés ne pouvait être considéré comme possédant un pouvoir absorbant égal pour des astres différemment colorés.

Dans ces conditions il nous a donc paru dangereux de nous servir d'un procédé qui est de nature à introduire dans les recherches des erreurs systématiques.

De l'ensemble de nos expériences nous avons été amenés à conclure qu'il ne fallait pas amoindrir l'intensité lumineuse au delà d'environ 3 grandeurs d'étoiles, si l'on ne veut pas s'exposer à des erreurs sensibles.

Le procédé utilisé pour pouvoir se rendre compte de l'action du verre neutre est fort simple.

Nous avons pris deux lumières, d'une nature identique, destinées à nous fournir deux images; et nous avons ensuite, à tour de rôle, affaibli l'une des images par l'éloignement de la source lumineuse, et l'autre par l'intervention de la plaque prismatique.

C'est de cette façon qu'il a été facile de distinguer des colorations très fortes et très différentes selon la nature du verre employé. Nous avons en outre, à l'aide du spectroscope, constaté l'existence de plusieurs bandes d'absorption. En résumé, aucun des verres n'a pu supporter d'une manière satisfaisante l'épreuve à laquelle nous les avons soumis; mais peut-être M. le professeur Pritchard a-t-il été plus heureux dans ses recherches pour se procurer un verre suffisamment neutre.

Pour échapper à ces difficultés, nous avons pensé à un autre procédé, à une disposition tellement simple, que nous demandons, comme M. le professeur Pritchard, si elle n'aurait pas été déjà proposée par quelque savant.

Nous avons introduit dans la lunette un diaphragme ayant l'ouverture de l'objectif et perforé d'un petit trou circulaire.

En faisant glisser ce diaphragme le long de l'axe optique, la quantité de lumière transmise sera inversement proportionnelle au carré de la distance par rapport au foyer.

Toute lunette munie d'un semblable diaphragme pourrait servir à mesurer l'éclat des étoiles: mais il est encore plus rationnel et plus avantageux de construire un instrument affecté

spécialement aux mesures photométriques. Cet appareil peut être réalisé d'une façon très simple et très peu couteuse. En effet, si l'on veut déterminer la différence d'éclat des dix premières grandeurs d'étoiles, il suffit, pour atteindre ce but, d'employer une petite lunette d'environ 35 millimètres d'ouverture, et de la munir d'un diaphragme mobile percé d'un trou de $0^{mm.}6$; à l'aide des lectures faites sur une échelle divisée, placeé le long de la lunette, il sera facile de calculer la différence d'éclat des astres comparés.

Toutefois, ce procédé ainsi utilisé pour la comparaison directe de 10 grandeurs d'étoiles présenterait de légers inconvénients. Selon la grandeur de l'astre, la plaque circulaire rétrécirait dans des proportions très différentes l'ouverture de l'objectif, et alors, d'une part, la quantité de lumière transmise pourrait ne pas être rigoureusement inversement proportionnelle au carré de la distance par rapport au foyer, et d'autre part, le disque stellaire, ne conservant pas le même diamètre, n'impressionnerait peut-être pas la rétine d'une manière identique.

Pour atténuer ces difficultés, il vaudrait mieux restreindre un peu l'amplitude de la comparaison directe, et ne se proposer que l'évaluation de 5 ou 6 grandeurs.

Pour opérer dans ces nouvelles conditions on peut employer divers procédés. Par exemple, avec la même lunette d'environ $35^{mm.}$ d'ouverture, munie d'un diaphragme perforé d'un trou circulaire de $3^{mm.}5$, on arrivera, en déplaçant le diaphragme, à éteindre les étoiles comprises entre la 5e et la 10e grandeur.

Mais si l'on veut, avec la même disposition, étudier des étoiles plus brillantes, il faudra placer devant l'oculaire, sous un angle de 45°, une lame non argentée de cristal de roche ou de verre ordinaire, destinée à diminuer préalablement par la réflexion l'intensité lumineuse. Pour nous rendre compte de l'action produite par la plaque de cristal, nous avons effectué des expériences physiques directes, et nous avons trouvé que le pouvoir réfléchissant des deux surfaces planes de cristal, taillées parallèlement à l'axe, est ègal à 0·111 de la lumière incidente.

On pourra, comme on le voit, étudier de cette façon les astres compris, à peu près, entre la 3e et la 7e grandeur.

En adaptant à la lunette, toujours sous un angle de 45°, au lieu d'une lame, deux lames parallèles séparées l'une de l'autre par l'ouverture de l'oculaire, il sera possible de mesurer depuis la 5e jusqu'au delà de la 1re grandeur.

En résumé, en employant cette méthode, on peut, par les combinaisons les plus diverses, comparer l'intensité relative d'éclat de toutes les grandeurs d'étoiles. Ainsi, avec une petite lunette de 1 centimètre d'ouverture ayant un diaphragme perforé d'un trou de 1 millimètre il sera facile, en utilisant les plaques de verre, de comparer entre elles toutes les étoiles comprises entre la 7e grandeur et les plus brillantes de notre ciel.

Toutefois, pour opérer avec sécurité, il faut, pendant l'opéra-

tion, soit à la main, soit à l'aide d'un mouvement d'horlogerie, maintenir l'axe au centre du champ.

Ce procédé présente un avantage marqué sur l'emploi du verre neutre : les quelques inconvénients signalés plus haut, qu'il laisse encore subsister, ne nous paraissent pas de nature à exercer une influence sensible sur les résultats que l'on peut obtenir par la méthode d'extinction : nous avons même pu constater, par l'expérience, que le disque stellaire, malgré le rétrécissement de l'ouverture, n'offre à la vue aucune différence appréciable d'aspect.

Nous étudions en ce moment une nouvelle disposition qui nous permettra d'atteindre dans des recherches photométriques la précision la plus rigoureuse, et nous espérons pouvoir en donner bientôt la description.

Note on the Employment of Photography in the Transit of Venus of 1882. By E. W. Maunder, Esq.

There is a very general feeling that the results obtained from the photographs taken during the Transit of *Venus* in 1874 are not sufficiently satisfactory to make it worth while to employ photography in the approaching Transit. There is, however, some probability that the circumstances of the Transit of this year may render it possible to attack the problem of the solar parallax in a wholly different manner to that employed in the treatment of the 1874 photographs. And as I have not seen this feature of the 1882 phenomenon adverted to in this connection, I have thought that it might be worth while to draw attention to it, though I cannot think that it has wholly escaped notice.

In measuring the 1874 photographs, the object sought to be attained was the determination of the distance between the centres of the Sun and of *Venus*. This necessitated of course the precise measurement of the position of the limbs of the Sun, and practically of the planet as well. But it was found that the limbs of the Sun were not measurable with anything approaching the required accuracy, and that *Venus* herself was also often strangely distorted. Instead of a hard, sharp, regular line, marking the frontier between light and darkness, the Sun was found to melt away gradually to nothingness, and the difficulty of determining *where* on that delicate shading was the true edge of the Sun, was often aggravated by the irregularities of a "boiling limb." The case was made worse in the English photographs by the need of arriving at the true radius of the Sun in order to find the value of the scale.

Some part of these difficulties were due, I think, to defects which might be readily obviated on a second attempt, for the uncertainty in the determination of the Sun's radius was certainly greater than that usually found in the measurement of the

series now being taken at Greenwich for Sun-spot observation. But it does not seem at present possible to *ensure* the taking of Sun-pictures in which the uncertainty in the determination of the position of the limb shall not be large as compared with the uncertainty in the solar parallax. It is possible, however, that in 1882 the parallax may be inferred without the measurement of the Sun's limb at all.

The Transit of 1874 happened at a time when the solar activity was rapidly declining, and as *Venus* passed across the Sun at a great distance from the centre running almost along the fifty-ninth parallel of North latitude, to which its path was but very slightly inclined, there was no possibility of its encountering or even approaching any solar marking which might serve as a fiducial point, for at that period spots did not wander further from the equator than latitude 15°, and faculæ than latitude 20°, and the manifestations of both orders of phenomena were becoming feeble. In December, 1882, on the contrary, we shall have reached, or at all events be not far from attaining, the time of maximum activity, and *Venus* will travel along a path which crosses the forty-second parallel of South latitude at a small angle. The planet's limb, therefore, from a southern station would be seen to touch the thirty-seventh parallel. It would not be an unprecedented event if there were a spot or spots in a position to be actually occulted by *Venus*, but the probability is very considerable that spots will be found between latitudes 20° and 30°, for this is the favourite *locus* of spots at times of greatest disturbance; so that there is good reason to expect that at some time during the Transit the limb of *Venus* will be within some two or three minutes of arc of a spot. And it is even more likely still that faculæ will be found near the one limb or the other, perhaps near both, extending across the planet's path.

In a lightly-exposed and slowly-developed picture the solar details are seen with great distinctness, and not only spots, but faculæ, and even less conspicuous and defined markings still, often offer easily recognisable points, the positions of which could be undoubtedly measured with the high degree of accuracy required. If then at one or more stations a long-focus photo-heliograph were employed similar to those used by Lord Crawford and the Americans, and by this instrument the distance between several well-marked points on the Sun's surface determined, a scale would be obtained that could be used for the other photo-heliographs, and no necessity would exist for measuring the Sun's limb at all. And it would, I think, be found that *Venus* would show a far more definite and regular outline on pictures taken with a small exposure than in the more fully exposed pictures of the last Transit.

In this manner the two great difficulties attending the reduction of the photographs of 1874 would be overcome: the limb of *Venus* would be more measurable, and that of the Sun left unattempted. There would be the further advantage of the

maximum distance to be measured being only three, four, or at the most five minutes of arc, instead of the whole diameter of the Sun, whilst the relative displacement of *Venus* as seen from two compared stations would generally exceed half a minute.

Then the combination of the pictures would be unrestricted, except that it would be necessary that only photographs which were taken nearly simultaneously should be compared. Thus if soon after ingress *Venus* were found to be near spots, or amongst faculæ giving one or two good points of reference, we might compare pictures taken, say, at Greenwich, Honduras, the Falklands, and Natal; and these might be combined in any pairs, the four photographs thus giving six determinations of parallax. Or near egress, photographs taken at San Francisco, at Auckland, and at Cordoba might be compared, when the three photographs, each taken with a Sun more than 30° high, would give three determinations of parallax, the factor in each case being fully 0·70.

This free combination of photographs would tend to in some degree eliminate the various sources of error. Thus where only three pictures were compared, three positions of *Venus* would be obtained, forming a triangle, the angles of which would be most precisely known. It is clear that no unsuspected cause of distortion, atmospheric, instrumental, or photographic, could so operate as to alter the length of the sides of the triangle—that is, the parallactic displacement of the planet—without betraying its presence by altering the angles as well. I fear the method of contacts provides no such check upon the errors to which it is liable.

If fortune so far favour the observers of the next Transit that *Venus* should occult some spots or well-marked faculæ, then the photographs will be of additional service, not only as themselves affording the means of determining afterwards the times of disappearance and reappearance, and as giving a determination of the parallax comparable in method with contact observations, while free from many of their drawbacks, but by enabling observers to note the times of the phenomena with their telescopes, with the consciousness that the particular marking observed could be afterwards identified.

But if, despite all the probabilities of the case, the Sun disappoint our legitimate expectations, and present a clear, unruffled countenance to us on the sixth of December next, then I venture to think that the following slight alterations might tend to secure an improvement in the results from the measurements of the separation of the centres. First, if collodion be used, the substitution of a wet process for a dry. The American photographs, which seem to have proved decidedly more measurable than our own, were wet plates, and the only good photograph secured by the English photographers was obtained by the same method.* Besides, the wet plates taken at Greenwich on every fine day certainly show limbs better adapted for measurement than do

* *Monthly Notices*, vol. xxxviii. p. 509.

a heavy percentage of the *Venus* plates. Some of the new gelatine processes might give even better results, but I have no personal experience of the behaviour of these plates under the micrometer, and I should not be inclined to expect any very good results from them. Next, a shortened exposure, and if possible a better means of making it than by the drop-slit as at present arranged. Thirdly, some means of securely clamping the instrument. The Dallmeyer photoheliographs are sadly deficient in clamping power. Lastly, a small finder added to each instrument would be a great improvement, and would have prevented the unfortunate failure of the Janssen method at Honolulu.

The most important station for photographic work would be the Falkland Islands; Santiago and Cordoba and other South American posts ranking next, as in all probability photographs will in any case be taken, both in Europe and the United States, supplying the needed corresponding northern stations. A photo-heliograph in Cape Colony and another in New Zealand would be desirable, but less essential. There is one already at work in the Mauritius, where ingress is visible at sunset, but the sun will be very low there. Cuba or Central America would also be good positions, but the post most necessary to be occupied is, as has been already stated, the Falkland Islands, there being but a poor chance of fine weather in the Straits of Magellan.

Blackheath:
1882, *January* 12.

The Relative Motions of the Great Red Spot and Brilliant Equatoreal Spot on Jupiter. By W. F. Denning, Esq.

In the early part of the night of December 24 the sky was shrouded in thick haze, through which *Jupiter* shone very dimly; but at about $9^h\ 35^m$ the atmosphere became much clearer, and I was enabled to observe the markings then visible on the planet. At $9^h\ 43^m$, with power 150 on my 10-inch Reflector, I noted the middle of the red spot and the bright equatoreal spot crossing the central meridian together. I had anticipated from comparative observations of the two objects on the nights of December 20, 22, and 23, that they must occupy the same longitude at this time, and the fact was thus proved by actual observation.

Now, on November 19, 1880, at $9^h\ 23^m$, I observed the same markings in conjunction as they came to transit; and I have watched the motions of these objects, as frequently as opportunity permitted, during the interval of 400 days and 20 minutes which has elapsed between the two observed conjunctions of November 19, 1880, and December 24, 1881.

The red spot has performed 967 rotations, but the white spot has circulated around *Jupiter* 976 times, or 9 times more than the red spot. The mean revolution of the bright spot, relatively to the position of the red spot, has therefore been 44 days 10^h 42^m $13^s.3$. The epochs of conjunction computed on this period, and dating from the first observation on November 19, 1880, are :—

	h	m	s
1880, November 19	9	23	0
1881, January 2	20	5	13
February 16	6	47	27
April 1	17	29	40
May 16	4	11	53
June 29	14	54	7
August 13	1	36	20
September 26	12	18	33
November 9	23	0	47
December 24	9	43	0

The two spots have, however, both shown irregularities of motion in the interval, so that, though the mean motion is represented by the period as above, the individual conjunctions derived from observation are not precisely conformable to the above times. Apart from this, the two objects near the epochs of their conjunction could not be always followed, owing to cloudy weather or to the unfavourable position of *Jupiter*. I have, however, derived the approximate times of actual conjunction from observations close to the dates on which they occurred as follows :—

Approximately Observed Conjunction.	h	m	Derived from Observations on	Observed Period of Revolution. d	h	m	Diff. from Mean 44^d 10^h 42^m. d	h	m
1881, Jan. 3	7	9	1880, Dec. 28 / 1881, Jan. 6	44	21	46	+0	11	4
			♃ near ⊙	Four periods averaging					
June 29	11	53	July 10	44	7	11	−0	3	31
Aug. 13	1	1	Aug. 8	44	13	8	+0	2	26
Sept. 26	7	32	Sept. 21 / 28	44	6	31	−0	4	11
Nov. 10	11	3	Nov. 14 / 15	45	3	31	+0	16	49
Dec. 24	9	43	Dec. 24	43	22	40	−0	12	2

Thus the observed times are very close to those computed for the conjunctions of June 29, August 13, and September 26, but

the conjunction of November 10 happened $16^h\ 49^m$ later than usual, while that of December 24 showed a nearly corresponding period the other way, for the time is earlier by $12^h\ 2^m$ than that predicted. In fact the revolution of the bright spot in the former case showed an excess of $1^d\ 4^h\ 51^m$ as compared with the latter. Between September 28 and October 17 the bright spot exhibited a remarkable deviation from its mean motion, for its longitude became displaced to the extent of $+13°$ E. The daily rate of rotation is 878°·48 as derived by Mr. Marth from a large number of observations, and while on September 28 the longitude of the white spot was 18°·4, it increased to 19°·4 on September 30, to 23°·5 on October 3, to 27°·4 on October 11, and to 31°·4 on October 17. This shows a great retardation, while the subsequent observations in November and December prove the motion to have been slightly accelerated. These curious variations have obviously originated the large difference between the periods of the last two revolutions of the spot.

I believe the observed times of conjunction given in the above table, though depending upon eye estimates, may be relied upon to within small limits of error. I have adopted the daily motion of the brilliant spot as $=8°{\cdot}1$ or $13^m\ 24^s$, as compared with the position of the red spot.

During the period July 8–December 24, 1881, I obtained 43 transits of the latter and 41 of the former. The bright spot is subject to temporary obscurations at periods which seem to be of irregular occurrence.

For the information of observers who desire further to trace the remarkable motions of these spots, I give the following computed times of conjunction for the ensuing year:—

		h	m	s
1882, February	6	20	25	13
March	23	7	7	27
May	6	17	49	40
June	20	4	31	53
August	3	15	14	7
September	17	1	56	20
October	31	12	38	33
December	14	23	20	47

It is probable that the brilliant spot has been perceptible for some years, though observers have not until recently been able to connect the observations made during several oppositions of the planet. Dr. F. Terby, of Louvain, observed a brilliant white spot N. of the *f.* end of the red spot on November 27, 1879, and January 11, 1880. One revolution of this object had evidently been completed in the interval of 45 days, and the position of Dr. Terby's spot, relatively to the red, is identical with that computed back for the brilliant spot now visible. The

conjunction of November 29, 1879, was also observed by Mr. Gledhill at Halifax. He noted a "bright gap" into N. border of the great South belt and slightly preceding the middle of the red spot (November 29, 1879, $6^h\ 30^m$). A collection of the sketches made during the last five years would undoubtedly allow some salient facts to be gleaned as to the previous history of this singular object.

Ashley Down, Bristol:
1881, *December* 26.

Observation of the Outer Satellite of Mars made at the Royal Observatory, Greenwich.

(*Communicated by the Astronomer Royal.*)

The satellites of *Mars* have been looked for on four nights during the present Opposition, viz. on Dec. 29 and 30, and January 6 and 9. On three nights the search was wholly unsuccessful, but on December 30 a single measure was secured of an object which is believed to have been *Deimos*, the outer satellite. It was glimpsed once or twice between 9^h and 11^h G.M.T., but at length it was steadily held for about three minutes, and a fairly satisfactory measure obtained.

1881, *December* 30.

Greenwich Mean Solar Time.	Greenwich Sidereal Time.	Distance in Arc.	Position-Angle.
h m s	h m s	″	° ′
11 7 51	5 45 56	46·6	242 16

The position-angle may perhaps be rather small.

The satellite was seen again a little later on, but clouds came up before another measure could be secured.

It is believed that *Phobos* was glimpsed three or four times between $8^h\ 30^m$ and $9^h\ 0^m$ G.M.T., and its distance was roughly estimated as 0·8 diameter of *Mars* clear of the disk, and its position-angle as about 240°.

Deimos was far more difficult to observe than during the Opposition of 1879.

The observation was obtained with the Great Equatoreal of $12\frac{3}{4}$ inches aperture. Observer, Mr. Maunder.

Royal Observatory, Greenwich:
1882, *January* 13.

Observations of the Transit of Mercury, November 7 and 8, 1881, made at the Melbourne Observatory.

(*Communicated by R. L. J. Ellery, Esq., Government Astronomer.*)

Notes by Mr. Ellery.

Morning fine, but sky covered with cirrus, which did not hide the Sun, but rendered precise observations of details difficult; the thickness of film variable. Used 8-inch telescope, with Herschelian prism and power of 125, with yellow smoke shade. Edge of Sun commenced to boil violently a few minutes just prior to time of first contact, and was so disturbed as to make the time of external contact so uncertain that it was not estimated. Internal contact very good at $11^h\,8^m\,0^s{\cdot}1$ ($19^h\,58^m\,44^s{\cdot}06$). As the planet passed on to the Sun's disk it appeared clearly attached by a broad smoky band to the edge, which faded away flickeringly to a mere filament, till at $11^h\,8^m\,23^s{\cdot}8$ ($19^h\,59^m\,7^s{\cdot}7$), the planet became quite free suddenly. At egress the clouds had almost entirely cleared away, and left the Sun quite clear for the latter phases. At $1^h\,15^m\,6^s$ a thin flickering line, not at all persistent, was seen to connect planet and limb intermittently. This quite disappeared before internal contact at $1^h\,15^m\,33^s{\cdot}41$, which was sharp and well defined, with no distortion of Sun's limb. External contact at egress, $1^h\,17^m\,12^s{\cdot}9$. The external contact was beautifully clear, and nothing remarkable was observed; not the slightest trace of any projection of the Sun's limb around the planet, nor any appearance of planet outside the Sun. Whenever *Mercury* was seen on the Sun's disk clear of clouds a white spot was visible on the planet's centre, ill defined, and impressing me with its being some optical or delusory effect.

d	h	m	s	
7	19	58	44·06	Internal contact at Ingress.
		59	7·7	Planet suddenly free of filament.
8	1	15	6	Thin flickering line connected planet and limb.
		15	33·41	Internal contact at Egress.
		17	12·9	External „

Melbourne Mean Time.

Notes by Mr. White.

Observed with the North Equatoreal of four and a half inches aperture. At ingress a positive eyepiece with power 82 was used, the shade being a light yellow. At egress a Herschelian prism was employed with a negative eyepiece magnifying 84 times, the shade being a wedge of neutral-tinted glass. The corrected times are as follows:—

d	h	m	s	
7	19	57	11·7	External contact at Ingress.
		58	47·2	Internal „
8	1	15	30·1	Internal contact at Egress.
		17	10·5	External „

Melbourne Mean Time.

The limb of the Sun became violently agitated in the neighbourhood of the planet about a minute before the time of external contact at ingress, and continued disturbed during the whole of this phase. When about two-thirds of the planet had entered on the Sun's disk, it assumed a pear shape, the narrow part being towards the Sun's edge. The time given as internal contact is when a thread of light was first seen between the two limbs. At egress the definition was exceedingly good; the contacts were formed without distortion or clinging.

Notes by Mr. Moerlin.

Instrument used, 4½-inch Equatoreal by Cooke, Herschelian prisms, negative eyepiece, magnifying power 60; the shade was of a yellow-green colour. The following are the observed phases:—

d	h	m	s	
7	19	57	23·0	External contact at Ingress
		59	43·0	Internal „
8	1	15	34·5	Internal contact at Egress.
		17	6·5	External „

Melbourne Mean Time.

The time of external contact at ingress very satisfactory, but the internal contact very likely too late, as there was a cloudiness between the edge of the Sun and the planet before a complete separation took place. The contacts at egress I consider good, no ligament or bead having been seen, but a clean and comparatively sharp contact.

Notes by Mr. Turner.

Instrument used, 12-inch Newtonian Reflector, full aperture, Herschelian positive diagonal eyepiece, power 71, with neutral shade.

Phenomenon of ingress not observed, sky being very hazy. During the entire transit the sky was more or less hazy, *Mercury* appearing as a small round spot, for the most part somewhat ill-defined.

At egress it cleared up considerably, and definition was all that could be desired—sharp, clear, and steady.

At $1^h\ 15^m\ 21^s$, Melbourne mean time, a ragged filament was thrown out between the planet and the Sun's limb; this lasted about two seconds, the filament then assuming a solid form.

At $1^h\ 16^m\ 4^s$ the planet was slightly past internal contact; *exact* internal contact could not be determined.

External contact took place at $1^h\ 17^m\ 7^s$; this was a most reliable observation, the Sun's limb being sharp and steady.

Transit of Mercury, 1881, *November* 7–8.

By John Tebbutt, Esq.

Everything turned out favourable for the observation of this important phenomenon. The instrument employed in the observations was the $4\frac{1}{2}$-inch Equatoreal Refractor with its full aperture. The eyepiece was a negative one, combined with Cooke's diagonal prism, the magnifying power being 120 diameters. The lens next to the prism was smoked, and a shade of a brownish-green colour was fitted on between the eye and the eye-lens. By this combination the Sun's limb was straw-coloured against a dark sky-background. The instrumental conditions were, indeed, almost precisely those under which the Transit of *Venus* was observed here in 1874. Owing to the new three-inch transit instrument being engaged in prime vertical work the observations for time were made with the old two-inch transit. Good sets of observations were obtained on the evenings both preceding and following the transit, and these were supplemented by a transit of *Regulus* just before the ingress. Filmy clouds began to form about the time of ingress, and gradually increased in density, but not so as to interfere with the observations. The mean time of the first external contact was noted as $7^{d}\ 20^{h}\ 20^{m}\ 43^{s}\cdot3$, but this observation was unsatisfactory owing to the fact that the indentation produced by the planet in the Sun's limb was very marked when first caught in the telescope. At $20^{h}\ 22^{m}\ 9^{s}\cdot8$, the limbs of the Sun and planet near the point of contact being pretty well defined, two or three rapid undulations of light occurred between the closing cusps, and the thread of light was at once established. Six and a half seconds later the band of light had become very distinct. With the exception of the momentary disturbance just mentioned there was nothing to interfere with the observation of the contact. There was no distortion of the planet; there was no black drop, no triangular black ligament like that experienced by me in May, 1878, nor was there even the shadowy connection observed at the contacts of *Venus* in 1874. The planet was frequently watched during its transit; it maintained its circular form throughout, but was not always equally black. At $20^{h}\ 45^{m}$ I for the first time remarked a faint whitish spot in the centre of the planet's disk; it was observed on several occasions subsequently, more particularly towards the egress. At $1^{h}\ 28^{m}$ during a slight tremor of the images, I noticed that this spot lengthened out, and formed for a few moments an ill-defined greyish streak across the disk. This phenomenon I believe to be an optical one, and not connected in any way with the planet itself. I watched carefully for the halo or ring sometimes seen round the planet during transit, but failed to detect any trace of such a phenomenon. I was equally unsuccessful in my search for a satellite. Shortly after ingress the planet passed near two

groups of Sunspots, and near the centre of the disk there was a large double spot, surrounded with an extensive but light penumbra. The details of this object were very marked and beautiful. In a smaller telescope the nucleus of this spot appeared round and unusually black, and by an inexperienced observer might at first have been mistaken for the planet itself. At the time of egress the Sun's limb, owing to the light clouds having become more dense, was somewhat fainter, but remarkably steady and well defined. The clearly defined limbs of the Sun and planet were seen quite up to the moment of contact, there being not the slightest distortion of either of them. There was no ligament, indeed, of any kind, either black or shadowy. At $8^{d}\ 1^{h}\ 38^{m}\ 54^{s}\cdot5$ the thread of light between the limbs was very fine; three seconds later it was broken and the internal contact was certainly complete. I estimated the planet to be centrally bisected at $1^{h}\ 39^{m}\ 43^{s}\cdot5$, and the notch in the Sun's limb vanished at $1^{h}\ 40^{m}\ 36^{s}\cdot5$. At no time did I succeed in observing the planet outside of the Sun's limb. Considering that shortly after the egress the clouds thickened so as to obscure the Sun, I may regard myself as greatly favoured in the work of observation. Seeing, too, that our Australian Observatories are the only ones from which a view of the whole transit could be obtained, the results arrived at will possess a greater interest. In conclusion I here present a *résumé* of the principal phases of the phenomenon in local mean time:—

	d	h m s
First external contact	Nov. 7	20 20 43·3
First internal contact	7	20 22 9·8
Last internal contact	8	1 38 57·5
Last external contact	8	1 40 36·5

Observatory, Windsor, N. S. Wales:
1881, *November* 12.

Note on the Transit of Mercury, 1881, *Nov.* 8.
By Dr. L. S. Little.

At sunrise *Mercury* was already some distance within the Sun's limb. The sky was cloudless, and continued so until after the Transit was over, with the exception of rare passing cumuli.

The air was unusually warm and damp; the thermometer was at 74° at the time the Transit was over, which is higher than it had been for nearly three weeks. On this account, perhaps, the definition of the Sun's surface and spots was never very good. It was certainly best soon after sunrise.

The instrument used was a five-inch Refractor, by Casella, reduced to four inches, with diagonal eyepiece, negative power of 150, and dark neutral-tint shades.

Mercury appeared blacker than the darkest part of the large Sunspot, but not so startlingly black as *Venus* appeared during Transit. He was always surrounded by a darkish halo, which

seemed well defined, extending to a distance about equal to the planet's semi-diameter. With no power could any spots on the planet be detected. He was seen throughout as a uniform, slightly purple, black disk.

The time of internal contact I found it impossible to determine at all accurately, but give it as noted at the time. The time of external contact was definite, and is simply the time when no portion of *Mercury* was any longer visible on the Sun's disk. I could see no trace of him after external contact.

Several photographs were taken with a lens of thirty-feet focus, but they are bad.

		h m s	
Internal contact at Egress	...	15 36 12	G. M. T.
External „	...	15 37 44	„

The time was taken by a sidereal chronometer, the error of which was determined on the morning and in the evening of the Transit.

Shanghai, 1881.

On an Object seen near Comet b, 1881, *on June* 10, 1881.

By W. Bone, Esq., M.D.

(*From two letters to the Secretaries.*)

(1.)

On June 10, 1881, whilst measuring the position of the Comet, then visible here at $5^h\ 52^m$ mean time of place, I noticed a peculiar discordance in each succeeding measure, and at length found that the star (?) from which I was measuring was a rapidly-moving body. At first I was inclined to believe it the result of refraction, but this should have affected both Comet and star nearly equally. On more careful inspection I found it was somewhat discoid, but its light, although bright, was diffused and hazy. It moved through 6′ of arc in $34^m\ 34^s$ of time, in a northerly direction. I immediately telegraphed down full particulars to the Melbourne Observatory, and asked for instructions. Bad weather prevented me from searching for it next morning, and in the evening I could not succeed in again picking it up, neither could I find it where seen on the preceding evening. I never received any answer from the Melbourne Observatory; but when in Melbourne a few days since I called there, and on reminding Mr. E. J. White of the circumstance, he said that Dr. Gould had stated he saw the nucleus split into two *about* that time; but I have since ascertained that it was so observed at Cincinnati on July 6.

This struck me as so remarkable that, acting on the principle of your society, "*Quicquid nitet notandum*," I determined to send you my record of the observation.

The approximate position of the body at that time was

	h	m	s
R. A.	5	18	8

	°	′	″
Dec. S.	14	18	0

If this Comet threw off an appendage on July 6 it might possibly have also done so shortly before I saw this body; and this may be a common phenomenon with comets, but noticed now in consequence of the larger aggregate amount of attention bestowed upon them by the increased number of observers. I am making all possible preparations for the approaching Transit of *Mercury*, and should be glad of any hints with regard to the Transit of *Venus* that might possibly render the efforts of an amateur of some degree of scientific value. I trust by that time to have my 8-in. telescope by Grubb erected.

Castlemaine, Victoria:
1881, *October* 22.

(2.)

Enclosed is the original telegram referred to in my communication to you a fortnight since:

Telegram to E. J. White, Esq. or R. L. J. Ellery, Esq, Observatory, Melbourne. Transmitted 1881, *June* 10, $8^h\ 10^m$ P.M.

"Whilst measuring Comet to-night found what I thought was star, discoid, and travelling south 6′ arc in 34^m time. Declination South, 14° 24′; Right Ascension, $5^h\ 18^m\ 30^s$ at 6.45 mean time. No asteroid in that place. Could not be refraction. Travelled 24^s in Right Ascension in same interval. Appeared like circular Comet. Reply. Will you search to-morrow morning?—W. Bone."

I have since seen in *Nature* of August 11, 1881, p. 342, a notice of Dr. Gould's having observed a similar phenomenon about two days after I had seen it, and the position given in my telegram to Mr. White at the Melbourne Observatory (which was never answered) makes it appear that it was actually another Comet we observed on those dates.

I should place the magnitude at about 2·5, for it was visible to the naked eye in first twilight. Its travel was perceptible between each set of comparisons, and amounted to 6′ in 34^m of time in Declination, moving 24^s in R.A. in the above time.

Castlemaine, Victoria:
1881, *November* 6.

Observations of the Transit of Mercury on November 7 and 8, 1881. By A. V. Nursinga Row, Esq., of Vizagapatam, India.

(*Communicated by request by Piazzi Smyth, Edinburgh.*)

The above well-known and liberal-minded amateur astronomer, computer, and meteorologist, commenced preparations for the above Transit by computing the times of the principal phases for his place of observation by Mr. Woolhouse's formula in the Appendix to the *Nautical Almanac* for 1836. In these computations he assumed the longitude of his Observatory at $5^h\ 33^m\ 30^s$ East; the geographical latitude $= 17°\ 42'\ 9''$ North; and the geocentric latitude $= 17°\ 35'\ 37''$. The computed times of the phases visible at Vizagapatam are:—

	h	m	s	
Middle of Transit ...	18	30	50	Vizagapatam Mean Time.
Internal contact at Egress	21	9	58	
External contact at Egress	21	11	41	

When the Sun rose on November 8, Civil reckoning, Mr. Nursinga Row was at the eye-end of his telescope, an excellent 6-inch objective one by Messrs. Cooke & Sons, equatoreally mounted under a revolving dome, and was prepared to observe the remainder of the Transit, the planet having entered on the disk of the Sun, and having almost completed half of its course at sunrise. He believes accordingly that he saw that the middle of the Transit occurred at $6^h\ 30^m\ 50^s{\cdot}4$ A.M. with a least distance for the centres of $3'\ 52''$. But at this stage of the proceedings there came pouring into his Observatory such a stream of his English lady and gentlemen friends, that Mr. Nursinga Row confesses he rather lost his presence of mind as an observer. The egress of the planet was afterwards beheld; and found to agree closely with the time computed beforehand.

The Merope Nebula. By Lewis Swift, Esq.

This nebula, so easily seen by some, and which is not at all discernible by others, even with the largest and best telescopes, is *par excellence* the greatest enigma in observational astronomy. That an object of such easy and unmistakable visibility through a 3-inch telescope should be wholly invisible through the $18\frac{1}{2}$-in. Refractor of the Chicago Observatory, seems at first thought to be at variance with the generally received opinion that the larger the telescope, the brighter an object appears.

My experience with this nebula has been as follows:—In 1874, while searching for comets, I ran upon it, and having never heard of a nebula in the *Pleiades*, strongly suspected that

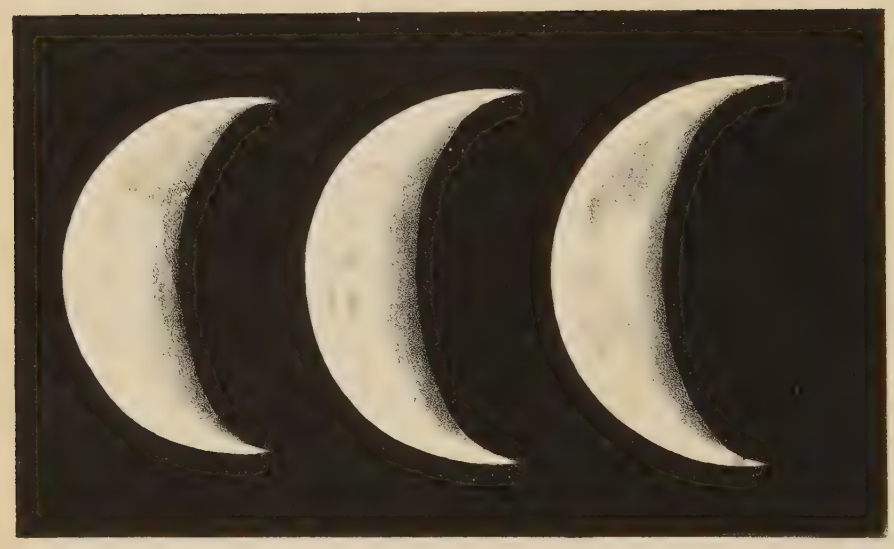
it was a new comet, which illusion the following night quickly dispelled, as the object was stationary. I wrote the fact to Mr. Burnham, who replied that it was a variable nebula, discovered by Tempel in 1859. Feeling a great interest in the object, I, from that time to the present, have not failed, on every favourable occasion, to carefully observe it for the purpose of satisfying myself as to the fact of its variability, with the result that for seven years it has shown to my eye and instrument no sign whatever of change. My object in inviting the attention of the readers of the *Notices* to this subject is, however, not to discuss this question of variability, but its existence, which to me is as palpable as that of the great nebula in the *Triangles* (M. 33), which, except in brightness, it greatly resembles. It is a far easier object to observe than the great nebula closely following *ζ Orionis* (H.V. 28=G.C. 1227). Though this latter nebula is catalogued as single, I make it quadruple.

I am told that no larger telescope will show it, even as a single nebula, from its close proximity to the overpowering light of the star. The question here arises—Why will not a large telescope be as effectual as a small one in revealing faint nebulæ close to very bright stars? The reason is obvious, though at a mere glance, apparently contrary to the well-known principle of optics, that two objects, in close juxtaposition, maintain the same relative brightness, whether the telescope be large or small. To me this law holds good only when star is compared with star, or nebula with nebula, and not when one body is a star which cannot be magnified, and the other a nebula which can. Then, too, with large telescopes, eyepieces of higher power are generally used and the field correspondingly contracted, and so, of course, the opportunity for contrasting the faint light of the nebula with the surrounding dark sky is diminished if not entirely lost.

Professor Hough and Mr. Burnham are unable to see, or even glimpse, the *Merope* nebula with the great Refractor of the Chicago Observatory, and they therefore doubt its existence. It is quite natural for those trained observers, with such an instrument, to call into question the reality of a nebula which they are unable to see—in fact, find darkness only where observers with small telescopes see a nebula. They ascribe the nebulous appearance to a halo surrounding *Merope*; but why do hundreds of people observe it around and following *Merope*, and not around and following *Alcyone* and the other bright stars of the group? It is certainly very strange that of all the stars in the heavens, *Merope* alone should show nebulosity immediately following it!

The object is quite large, and appears triangular with the corners rounded off. Though quite faint, I have seen it with a 2-in. aperture on my 4½-in. telescope, using my comet eyepiece, power 25.

VENUS. 1881.



Mar. 22, 6h. *Mar. 26, 7h.* *Mar. 28, 6½h.*

Mar. 30, 6¾h. *Mar. 31, 6¾h.* *Apr. 5, 6¼h.*

W. F. Denning, del.

Lemercier & Cie Lith. Paris

If Messrs. Hough and Burnham will contract the aperture of their telescope to from 4 to 6 inches, and use a power of about 30, they will see as a reality what they now believe to be a myth.

Rochester, N.Y.:
1881, *December 2.*

Observations of Venus in the Spring of 1881.

By W. F. Denning, Esq.

In the months of March and April 1881 *Venus* became a splendid object in the evening sky, and I undertook a series of observations chiefly in those months, with a view to recover the delicate markings recorded by some earlier observers. The first observation was made on December 10, 1880, but the planet was near the horizon, and her diameter only 13″·8, so that nothing definite was seen.

1880, *December* 20, $3^h\ 40^m$–$4^h\ 5^m$.—*Venus* well defined with power 200. There were spots of the most certain character, though extremely faint.

1881, *January* 6, $3^h\ 50^m$–$4^h\ 5^m$: power 200.—Some minute markings or centres of shading, apparently giving the surface a mottled aspect, just barely discerned. A few light specks were apparent towards the circular contour of the W. limb, where the brightness of the disk was very conspicuous.

January 31, 5^h. No dark markings distinguished.

February 16, 5^h–$5\frac{1}{2}^h$.—*Venus* splendidly defined. The N. horn evidently the sharpest. There were cloudy condensations distributed over the planet's surface except around the W. border, where the brightness was very intense. I suspected crater-like objects of very minute type on the terminator, and a shading running from the N. horn about one-third round, and parallel to the bright interior edge of the planet.

March 1, $4\frac{1}{2}^h$–$5\frac{1}{2}^h$.—Faint dusky patches again seen, but they were extremely delicate, and only caught during moments of superb definition.

March 22, 5^h–7^h.—No distinct spots seen, though at times I suspected minute shadings elongated in latitude between terminator and W. limb. No spots or crater-like objects on the terminator, which is evidently not serrated as some observers have described it. The cusps were markedly bright; so was the surface round the W. limb, but the terminator was much shaded. The rippling appearance of the planet, especially when the air is unsteady, naturally gives the impression of a jagged terminator and mottled aspect of the entire disk as noted by some observers. But though to-night the planet's disk was very closely examined for detail, these appearances could not be certainly descried. The terminator showed some gentle undulations, but there was

an entire want of that remarkably rugged outline depicted in some sketches.

March 26, $6\frac{1}{2}^h$–$7\frac{1}{4}^h$.—Definition not nearly so good as last night, when the view was nearly perfect. Disk apparently mottled with grey patches and intervening luminous veins or striations, but these may have been due to tremor. I noticed that the cusps were very brilliant and sharp, extending considerably beyond the half-circle, and obviously different from the ordinary Moon-crescent, but in the case of two bodies presumably so distinct in physical characteristics, we cannot expect close agreement. Atmospheric refraction in the case of a planet enveloped in deep and dense air-strata must necessarily diffuse sunlight over a greater area of the surface than in the case of a planet with a non-appreciable atmosphere like the Moon, which can only be illuminated over those parts directly exposed to the Sun. *Venus*, however, would always be reflective more than half hemisphere, and this must cause the anomalous prolongation of the cusps so often noticed and possibly account for the visibility of the whole circle of the planet when near her inferior conjunction.

March 28, 6^h–7^h.—A bright, small spot detected just within N. cusp, and a very faint cloudy area extending from the terminator towards W. limb in S. hemisphere. Also a grey shading in N. hemisphere, running from the terminator. Definition was splendid, power 290, and Barlow lens increasing it to 400, gave excellent views. The mottled aspect of the planet was far less obvious to-night; indeed, I usually find it difficult when definition is good.

March 30, 0^h 30^m.—Definition execrable; indeed, it was invariably found that observations when attempted with the Sun high above the horizon were utterly useless. The atmosphere is too brilliantly illuminated by the Sun's rays and its tremors rendered too strikingly apparent to allow even a lustrous object like *Venus* to be seen with good effect, and it is surprising that such a time is often recommended as eminently suited for such work. We must admit that the glare of *Venus* is considerably moderated in the presence of sunshine, but this effect, though essential in some degree, is brought about by the highly luminous condition of our atmosphere, which unfortunately then reveals its disturbing elements to the utmost degree. During the observation of to-day *two* crescents were seen in the field of view while employing a Kellner comet-eyepiece, power 38, and Barlow lens. There was a large and faint crescent almost central in the field, and a small bright crescent (the real image of the planet) situated slightly to the W. of it. The reputed observations of a satellite of *Venus*, described in astronomical text-books, immediately recurred to me, but it was palpable that the large crescent now seen was a mere spectral appearance. Curiously enough, the two crescents were turned the same way; in fact, one seemed an exact counterpart of the other as regards

phase. The smaller one was estimated one-sixth the apparent diameter of the larger. The eyepiece was rotated without any displacement in the relative positions of the objects and then removed from the instrument. On looking into the tube at the small diagonal plane, the explanation became obvious. The sunshine streaming into the main aperture of the telescope fell partially upon the small sliding tube carrying the eyepiece, and formed a bright crescent upon the west side, this being feebly reflected in an inverted form through the eyepiece, and thus the "ghost" was originated. The explanation was extremely simple, and I have no doubt that the alleged observations of a satellite of *Venus* made in the last century were capable of a similar solution—indeed, it is hard to think that the origin of such illusions can escape discovery if carefully sought after.

March 30, $6\frac{1}{2}^h$–7^h.—Bright spot still at N. horn, and the cloudy diffused spot over S. hemisphere. The terminator evidently undulatory in its real figure, and I carefully noted it with power 400. There was a dark notch in it near N. horn, and near the bright spot before alluded to. The latter is extremely small, and looks like a crater, though I could not be certain of this.

March 31, $6\frac{1}{4}^h$–$6\frac{3}{4}^h$.—Appearance of *Venus* somewhat similar to that depicted last night, except that the markings appeared to have gone slightly westward. The bright spot and dark notch near the N. horn were again seen, though the former was not so distinct as on the previous nights. Definition was good with 200 and 290, and very fair with 400.

April 1, 0^h 30^m.—Observed *Venus*, but definition was very unsatisfactory, and no details could be made out. The spectral crescent was again seen as on March 30.

April 2.—High wind, but the sky very clear. *Venus* could not be observed with high powers owing to the constant vibrations of the telescope.

April 5, 6^h–$6\frac{1}{2}^h$.—The crescent evidently much narrower. There is a faint shading over the apparent N. hemisphere and an indentation at N. cusp, which is very plain, though to-night it appears further from the extremity of the cusp than on the 30th and 31st, but it may not be identical. I strongly suspected the disk to be variegated with alternating light and grey markings, and the terminator to show minute bright specks. I repeatedly had the impression of one situated between the N. cusp and centre of terminator. It looked like a longish curling speck just merging out of the dark contour of the unilluminated hemisphere. The two cusps were notably bright: indeed, their intensity is striking compared with the region near the terminator, which is invariably much shaded. The difficulty in speaking positively as to the mottled or granulated aspect of the planet's disk and the occurrence of craterlike objects on the borders of the terminator arises from two causes—viz. their minute character and the unsteadiness of the image brought about by atmospheric undulations. The surface of the planet

can, it is true, never be viewed absolutely free from that rippling or tremulous motion originated by the continual transit of air-waves across the disk; and it is not difficult to understand the indistinctness and uncertainty with which minute objects such as these are viewed under the influence of these moisture-laden currents. *Venus* by her excessive lustre is much affected by such phenomena, but some excellent views of this planet may be obtained at about the time of sunset. My own observations indicate that the most suitable period of observation is from half an hour before to half an hour after sunset, when I have usually had no difficulty in obtaining a sharply-defined image of the planet.

Briefly summarising the foregoing results, it would appear that there are dark shadings upon the planet, and light areas with occasional bright spots near the cusps. The latter are very bright: so are the limbs; while the interior region is less luminous, and there is a gradual shading off towards the terminator, which does not show a distinctly serrated or jagged aspect, though its contour is evidently undulatory, with sometimes an indentation sufficiently obvious to command attention. As to the craterlike objects suspected near the terminator, I believe they are illusory, and caused by the rippling of the telescopic image. It is difficult to conceive that such objects could be perceived upon *Venus*, unless we assume that she has little or no atmosphere, which is impossible, when we consider that the prolongation of the cusps and other phenomena distinctly affirm its existence. There is no doubt that this planet requires very delicate observations, and that her configuration is by no means as devoid of interest as is frequently asserted.

It will be seen by the sketches, and it is a fact I several times noted during my observations, that the positions of the spots compared at similar times on consecutive nights showed a slight movement westward. This approximately confirms the rotation of $23^h\ 21^m$ given by Cassini and others. The axis appears to be greatly inclined, for the direction of the spots was from about SSE. to NNW. referred to the line of the cusps.

Bianchini, who observed many dark spots on the planet in 1726–7 with a telescope of 66 feet focus and $2\frac{1}{2}$ inches aperture, gave an erroneous rotation period of 24 days 8 hours. But his observations are reliable, though he put a wrong construction upon them. The markings which he noted as occupying the same positions at an interval of 24 days 8 hours had completed 25 circuits around the planet in the meantime. An observer who notes the progressive westerly movement of the spots as compared at nearly the same times on successive nights would certainly infer a period nearly agreeing with that formerly deduced by Bianchini, but when the markings are watched for two or three hours on the same night their swifter motion becomes evident. There are many difficulties, however, in the way of tracing the spots during long and regular periods.

Ashley Down, Bristol:
1881, *November* 10.

Observations of Jupiter's Satellites made at the Observatory, Madras.

(*Communicated by N. R. Pogson, Esq., Government Astronomer.*)

Date. 1862.	Madras Mean Time. By Obser. h m s	By N. A. m s	Phenomenon and Phase.	Telescope. Maker.	Power.	Initials of Observer.
Feb. 15	10 56 35·0	56 23	I. Ec. D. *e*	Tulley	180	N. R. P.
18	12 4 53·3	2 10	III. Ec. D. *e*	,,	134	,,
Mar. 3	9 12 7·8	11 44	I. Ec. D. *e*	,,	180	,,
	9 25 48·8	26 0	II. Oc. R. *b*	,,	180	,,
	11 39 9·8	40 0	I. Oc. R. *b*	,,	180	,,
10	11 5 7·9	5 25	I. Ec. D. *e*	,,	134	,,
May 4	10 1 44·6	1 48	I. Ec. R. *b*	Lerebours	66	,,
1866. Sept. 20	8 11 46·7	12 9	I. Ec. R. *b*	,,	66	,,
1868. Jan. 8	7 37 30·7	39 21	III. Ec. D. *e*	,,	66	,,
Oct. 28	8 17 48·3	17 16	II. Ec. R. *b*	,,	106	,,
	8 42 0·3	46 0	I. Sh. E. *e*	Simms	166	,,
1869. Jan. 13	8 43 27·5	43 14	I. Ec. R. *b*	Tulley	100	,,
Feb. 21	7 19 13·2	19 6	I. Ec. R. *b*	Lerebours	106	,,
Mar. 5	7 14 21·9	14 20	II. Ec. R. *b*	Simms	102	E. I. P.
	7 14 21·2	14 20	II. Ec. R. *b*	Lerebours	106	N. R. P
Dec. 10	7 57 11·8	57 23	I. Ec. R. *b*	Simms	165	,,
1870. Feb. 1	10 26 46·2	26 41	I. Ec. R. *b*	,,	105	E. I. P.
	10 26 32·3	26 41	I. Ec. R. *b*	Lerebours	106	J. P. B.
2	7 40 12·5	38 36	II. Ec. D. *e*	Simms	105	E. I. P.
	7 39 27·7	38 36	II. Ec. D. *e*	Lerebours	106	N. E. P.
	7 39 49·7	38 36	II. Ec. D. *e*	Tulley	100	N. R. P.
	9 54 25·6	55 55	II. Ec. R. *b*	Simms	105	E. I. P.
	9 54 29·6	55 55	II. Ec. R. *b*	Tulley	100	N. R. P.
9	10 15 57·2	14 24	II. Ec. D. *e*	Simms	105	J. P. B.
	10 14 32·5	14 24	II. Ec. D. *e*	Lerebours	106	E. I. P.
	10 15 13·0	14 24	II. Ec. D. *e*	Tulley	100	N. R. P.
10	6 51 16·6	51 38	I. Ec. R. *b*	Simms	105	E. I. P.
	6 51 22·0	51 38	I. Ec. R. *b*	Lerebours	106	J. P. B.
	6 51 32·6	51 38	I. Ec. R. *b*	Tulley	100	N. R. P.
17	8 46 50·0	47 35	I. Ec. R. *b*	Simms	105	E. I. P.
	8 47 33·7	47 35	I. Ec. R. *b*	Lerebours	106	N. E. P.
	8 47 38·2	47 35	I. Ec. R. *b*	Tulley	100	N. R. P.

Date. 1870.	Madras Mean Time. By Obser. h m s	By N. A. m s	Phenomenon and Phase.	Telescope. Maker.	Power.	Initials of Observer.
Feb. 20	10 41 38·7	39 26	III. Ec. D. *e*	Lerebours	63	G.W.B.
	10 41 16·3	39 26	III. Ec. D. *e*	Tulley	52	E. I. P.
27	7 0 22·6	2 25	II. Ec. R. *b*	Simms	163	R. F. C.
	7 0 52·7	2 25	II. Ec. R. *b*	Lerebours	106	N. E. P.
	7 0 55·7	2 25	II. Ec. R. *b*	Tulley	134	N. R. P.
Mar. 6	9 35 38·1	38 43	II. Ec. R. *b*	Lerebours	63	E. I. P.
	9 35 40·1	38 43	II. Ec. R. *b*	Tulley	100	R. F. C.
1871. Jan. 5	11 32 27·4	32 46	I. Ec. R. *b*	Tulley	100	N. R. P.
21	9 51 53·3	52 18	I. Ec. R. *b*	Simms	105	N. E. P.
	9 51 53·4	52 18	I. Ec. R. *b*	Tulley	100	N. R. P.
23	9 8 57·7	10 3	III. Ec. R. *b*	Simms	105	N. E. P.
	9 7 21·3	10 3	III. Ec. R. *b*	Tulley	100	N. R. P.
27	9 49 6·6	50 26	II. Ec. R. *b*	,,	100	,,
	11 28 56·5	24 0	I. Tr. I. *b*	Simms	102	N. E. P.
	11 26 9·3	24 0	I. Tr. I. *b*	Tulley	187	N. R. P.
	12 26 57·0	25 0	I. Sh. I. *b e*	Simms	102	N. E. P.
	12 25 59·9	25 0	I. Sh. I. *b*	Tulley	187	N. R. P.
	13 38 38·8	39 0	I. Tr. E. *b e*	Simms	102	N. E. P.
	13 39 48·0	39 0	I. Tr. E. *e*	Tulley	187	N. R. P.
28	8 34 5·7	33 0	I. Oc. D. *b e*	Simms	163	N. E. P.
	8 33 34·2	33 0	I. Oc. D. *b e*	Tulley	250	N. R. P.
	11 47 29·1	47 51	I. Ec. R. *b*	Simms	163	N. E. P.
	11 47 34·4	47 51	I. Ec. R. *b*	Tulley	134	N. R. P.
30	10 42 8·4	39 15	III. Ec. D. *e*	,,	134	,,
Feb. 3	7 39 57·4	38 0	II. Oc. D. *e*	,,	134	,,
	12 24 58·5	26 11	II. Ec. R. *b*	,,	134	,,
4	10 22 53·8	23 0	I. Oc. D. *e*	,,	100	,,
	13 43 20·1	43 29	I. Ec. R. *b*	,,	100	,,
6	8 12 2·4	12 28	I. Ec. R. *b*	,,	100	,,
	10 2 13·0	59 0	III. Oc. D. *e*	,,	100	,,
13	10 7 50·3	8 11	I. Ec. R. *b*	,,	100	,,
21	6 53 33·7	55 25	II. Ec. R. *b*	,,	138	,,
28	9 29 33·9	31 1	II. Ec. R. *b*	,,	100	,,
Mar. 7	6 45 44·3	43 2	III. Ec. D. *e*	Simms	120	,,
	6 55 18·7	52 0	II. Oc. D. *e*	,,	120	,,
8	10 24 7·0	24 32	I. Ec. R. *b*	,,	120	,,
14	10 46 55·8	43 47	III. Ec. D. *e*	,,	120	,,
	10 46 37·6	43 47	III. Ec. D. *e*	Lerebours	165	N. E. P.

Date. 1871.	Madras Mean Time. By Obser. h m s	By N. A. m s	Phenomenon and Phase.	Telescope. Maker.	Power.	Initials of Observer.
Apr. 1	9 9 20·8	10 50	II. Ec. R. *b*	Simms	105	N. R. P.
19	6 49 49·5	46 32	III. Ec. D. *e*	„	105	„
	6 49 34·5	46 32	III. Ec. D. *e*	Lerebours	164	N. E. P.
	9 31 2·0	31 27	III. Ec. R. *b*	„	164	„
1874.						
Jan. 29	11 18 31·9	17 5	II. Ec. D. *e*	Simms	195	N. R. P.
	11 19 19·0	17 5	II. Ec. D. *e*	Lerebours	160	E. I. P.
1875.						
Apr. 7	12 4 22·4	6 0	I. Sh. E. *b m e*	Lerebours	160	N. R. P.
	12 14 53·5	19 0	I. Tr. E. *b m e*	Simms	163	E. I. P.
	12 15 9·6	19 0	I. Tr. E. *b m e*	Lerebours	160	N. R. P.
8	9 34 27·2	37 0	I. Oc. R. *b*	Simms	163	E. I. P.
	9 35 15·7	37 0	I. Oc. R. *b m e*	Lerebours	160	N. R. P.
13	9 18 20·6	12 0	II. Sh. I. *b e*	„	160	„
	9 36 25·4	26 0	II. Tr. I. *b*	Simms	163	E. I. P.
	9 25 55·6	26 0	II. Tr. I. *b m e*	Lerebours	160	N. R. P.
	11 39 57·2	43 0	II. Sh. E. *b*	Simms	163	E. I. P.
	11 38 52·2	43 0	II. Sh. E. *b m e*	Lerebours	160	N. R. P.
	11 46 45·6	50 0	II. Tr. E. *b e*	Simms	163	E. I. P.
	11 44 14·6	50 0	II. Tr. E. *b m e*	Lerebours	160	N. R. P.
15	9 8 57·6	8 34	I. Ec. D. *e*	Simms	163	E. I. P.
	9 8 47·0	8 34	I. Ec. D. *e*	Lerebours	106	N. R. P.
	11 18 27 9	21 0	I. Oc. R. *b*	„	106	„
27	8 23 41·0	25 1	III. Ec. R. *b*	Simms	163	E. I. P.
	8 23 58·5	25 1	III. Ec. R. *b*	Lerebours	106	N. R. P.
29	11 10 1·0	11 55	II. Ec. R. *b*	Simms	163	E. I. P.
	11 9 25·4	11 55	II. Ec. R. *b*	Lerebours	108	N. R. P.
May 1	9 32 25·0	32 41	I. Ec. R. *b*	Simms	163	E. I. P.
	9 32 35·7	32 41	I. Ec. R. *b*	Lerebours	106	N. R. P.
4	8 51 31·0	42 0	III. Oc. D. *e*	Simms	163	E. I. P.
	8 48 38·2	42 0	III. Oc. D. *e*	Lerebours	160	N. R. P.
	12 20 24·8	22 26	III. Ec. R. *b*	Simms	163	E. I. P.
	12 20 33·8	22 26	III. Ec. R. *b*	Lerebours	160	N. R. P.
6	10 23 30·7	26 0	II. Oc. D. *b m e*	Simms	163	E. I. P.
	10 25 46·6	26 0	II. Oc. D. *b m e*	Lerebours	160	N. R. P.
	13 45 49·0	48 29	II. Ec. R. *b*	Simms	163	E. I. P.
	13 45 48·8	48 29	II. Ec. R. *b*	Lerebours	160	N. R. P.
8	11 26 29·8	26 42	I. Ec. R. *b*	Simms	105	E. I. P.
	11 26 26·9	26 42	I. Ec. R. *b*	Lerebours	106	N. R. P.

Date. 1875.	Madras Mean Time. By Obser. h m s	By N. A. m s	Phenomenon and Phase.	Telescope. Maker.	Power.	Initials of Observer.
May 11	12 3 24·3	0 0	III. Oc. D. *b m e*	Simms	163	E. I. P.
	12 3 57·2	0 0	III. Oc. D. *b m e*	Lerebours	160	N. R. P.
	14 3 26·0	4 0	III. Oc. R. *b*	Simms	163	E. I. P.
	14 3 24·7	4 0	III. Oc. R. *b*	Lerebours	160	N. R. P.
	14 21 38·0	19 25	III. Ec. D. *e*	Simms	105	E. I. P.
	14 22 53·5	19 25	III. Ec. D. *e*	Lerebours	106	N. R. P.
15	9 54 4·0	55 0	II. Tr. E. *e*	Simms	163	E. I. P.
	9 54 39·8	55 0	II. Tr. E. *b m e*	Lerebours	160	N. R. P.
	10 32 22·0	32 0	I. Oc. D. *b m e*	Simms	163	E. I. P.
	10 32 41·1	32 0	I. Oc. D. *b m e*	Lerebours	160	N. R. P.
	11 8 44·3	16 0	II. Sh. E. *b e*	Simms	163	E. I. P.
	11 9 17·4	16 0	II. Sh. E. *b m e*	Lerebours	160	N. R. P.
	13 20 33·2	20 49	I. Ec. R. *b*	Simms	105	E. I. P.
	13 20 26·5	20 49	I. Ec. R. *b*	Lerebours	106	N. R. P.
17	7 49 10·7	49 21	I. Ec. R. *b*	Simms	105	E. I. P.
	7 50 5·7	49 21	I. Ec. R. *b*	Lerebours	106	N. R. P.
22	9 49 26·2	44 0	II. Tr. I. *b m e*	Simms	163	E. I. P.
	9 51 1·4	44 0	II. Tr. I. *b m e*	Tulley	262	N. R. P.
	10 0 4·7	14 0	III. Sh. E. *b m e*	,,	262	,,
	11 23 8·9	19 0	II. Sh. I. *b*	Simms	163	E. I. P.
	11 23 5·0	19 0	II. Sh. I. *b*	Lerebours	160	N. R. P.
	12 11 52·9	13 0	II. Tr. E. *b m e*	Simms	163	E. I. P.
	12 11 28·2	13 0	II. Tr. E. *b m e*	Lerebours	160	N. R. P.
	12 18 55·0	18 0	I. Oc. D. *b m e*	Simms	163	E. I. P.
	12 19 46·2	18 0	I. Oc. D. *b m e*	Lerebours	160	N. R. P.
23	10 18 53·6	18 0	I. Sh. I. *b m e*	Simms	163	E. I. P.
	10 18 39·4	18 0	I. Sh. I. *b e*	Lerebours	160	N. R. P.
	11 40 11·9	42 0	I. Tr. E. *b m e*	Simms	163	E. I. P.
	11 39 24·8	42 0	I. Tr. E. *b m e*	Lerebours	160	N. R. P.
	12 27 56·4	31 0	I. Sh. E. *b m e*	Simms	163	E. I. P.
	12 27 51·8	31 0	I. Sh. E. *b*	Lerebours	160	N. R. P.
24	6 44 56·0	45 0	I. Oc. D. *b m e*	,,	160	,,
	9 43 8·6	43 35	I. Ec. R. *b*	Simms	105	E. I. P.
	9 43 13·1	43 35	I. Ec. R. *b*	Lerebours	106	N. R. P.
June 9	8 10 17·2	43 0	III. Ec. R. *b*	,,	106	,,
	8 10 18·2	43 0	III. Ec. R. *b*	Simms	106	E. I. P.
1876. May 19	10 41 58·2	41 36	I. Ec. R. *b*	,,	143	E. I. P.
	10 42 8·1	41 36	I. Ec. R. *b*	Lerebours	106	N. R. P.

Date. 1876.	Madras Mean Time. By Obser. h m s	By N. A. m s	Phenomenon and Phase.	Telescope. Maker.	Power.	Initials of Observer.
May 24	9 18 36·6	20 44	II. Ec. R. *b*	Simms	145	E. I. P
	9 18 49·1	20 44	II. Ec. R. *b*	Lerebours	106	N. R. P.
25	8 13 29·8	12 0	III. Oc. D. *b e*	Simms	105	E. I. P.
	8 13 16·4	12 0	III. Oc. D. *b m e*	Lerebours	165	N. R. P.
	10 34 7·4	38 47	III. Ec. R. *b*	Simms	145	E. I. P.
	10 35 36·9	38 47	III. Ec. R. *b*	Lerebours	105	N. R. P.
26	10 15 0·6	13 0	I. Oc. D. *b m e*	Simms	145	E. I. P.
	10 13 31·7	13 0	I. Oc. D. *b m e*	Lerebours	160	N. R. P.
	12 36 18·7	35 43	I. Ec. R. *b*	Simms	145	E. I. P.
	12 35 46·5	35 43	I. Ec. R. *b*	Lerebours	160	N R. P.
27	7 17 58·4	20 0	I. Tr. I. *b m e*	Simms	145	E. I. P.
	7 36 32·8	20 0	I. Sh. I. *b e*	„	163	E. I. P.
May 27	9 30 29·6	32 0	I. Tr. E. *b m e*	Simms	225	E. I. P.
	9 30 39·8	32 0	I. Tr. E. *b m e*	Lerebours	160	N. R. P.
	9 42 43·3	46 0	I. Sh. E. *b m e*	Simms	163	E. I. P.
	9 42 40·8	46 0	I. Sh. E. *b e*	Lerebours	160	N. R. P.
June 11	10 52 39·4	52 48	I. Ec. R. *b*	Simms	145	E. I. P.
	10 52 39·3	52 48	I. Ec. R. *b*	Lerebours	105	N. R. P.
Aug. 3	8 55 51·7	56 36	II. Ec. D. *e*	Simms	163	E. I. P.
	8 57 20·2	56 36	II. Ec. D. *e*	Lerebours	106	N. R. P.
	9 46 28·2	46 0	I. Oc. D. *b m e*	Simms	163	E. I. P.
	9 46 53·0	46 0	I. Oc. D. *b*	Lerebours	106	N. R. P.
1878. Aug. 20	10 15 9·9	13 50	I. Ec. R. *b*	Simms	105	B. B. H.
Sep. 19	8 55 13·3	57 0	I. Oc. D. *b e*	„	163	E. I. P.
	8 55 36·1	57 0	I. Oc. D. *b e*	Lerebours	160	N. R. P.
	12 23 50·2	23 42	I. Ec. R. *b*	Simms	105	E. I. P.
	12 23 17·9	23 42	I. Ec. R. *b*	Lerebours	106	N. R. P.
21	6 52 36·8	52 31	I. Ec. R. *b*	Simms	105	E. I. P.
	6 52 4·3	52 31	I. Ec. R. *b*	Lerebours	106	N. R. P.
28	8 47 47·7	47 53	I. Ec. R. *b*	Simms	105	E. I. P.
	8 47 59·3	47 53	I. Ec. R. *b*	Lerebours	106	N. R. P.
Oct. 1	11 27 56·9	28 38	II. Ec. R. *b*	Simms	102	E. I. P.
	11 28 3·6	28 38	II. Ec. R. *b*	Lerebours	106	N. R. P.
2	6 41 40·4	41 49	III. Ec. D. *e*	Simms	73	„
5	7 7 50·2	8 0	I. Oc. D. *b m e*	„	160	E. I. P.
	7 7 34·9	8 0	I. Oc. D. *b m e*	Tulley	100	N. R. P.
14	7 7 38·8	7 33	I. Ec. R. *b*	Simms	102	C. A. P.
	7 7 47·8	7 33	I. Ec. R. *b*	Lerebours	106	N. R. P.

Date. 1870.	Madras Mean Time. By Obser. h m s	By N. A. m s	Phenomenon and Phase.	Telescope. Maker.	Power.	Initials of Observer.
Oct. 19	10 55 2·7	10 56	I. Oc. D. *b e*	Lerebours	160	E. I. P.
21	9 2 50·8	2 55	I. Ec. R. *b*	„	106	C. A. P.
	9 2 54·3	2 55	I. Ec. R. *b*	Tulley	100	N. R. P.
	10 8 1·2	13 0	IV. Oc. D. *b e*	Simms	163	E. I. P.
	10 8 8·0	13 0	IV. Oc. D. *b e*	Lerebours	160	N. R. P.
1880. Dec. 13	7 16 32·3	15 0	I. Oc. D. *e*	Simms	165	S. B. H.
	10 44 8·9	44 34	I. Ec. R. *b*	„	102	„
	10 44 13·1	44 34	I. Ec. R. *b*	Lerebours	105	E. I. P
1881. Feb. 5	7 0 46·0	0 0	I. Tr. I. *b m e*	„	160	E. I. P.
	8 14 24·9	10 0	I. Sh. I. *b e*	„	160	„

Date. 1862.	Observer.	Notes.
Feb. 15	N. R. P.	Faded away gradually for about 10ˢ.
18	„	Fading for about 4ᵐ, and uncertain for about 4ˢ.
March 3	„	First satellite fading for 9ˢ at eclipse.
	„	Second satellite about 1ᵐ in getting clear of the disk.
	„	The night windy and cloudy during the third observation.
10	„	Fading for about 23ˢ.
May 4	„	Increasing about 1ᵐ 15ˢ.
1866. Sept. 20	N. R. P.	Increasing for about 15ˢ.
1868. Oct. 28	N. R. P.	Second satellite increasing for about 1ᵐ 15ˢ.
	„	Last trace of shadow emersion of first satellite.
1869. Feb. 21	N. R. P.	Pretty sudden, but nearly 2ᵐ regaining ordinary brilliancy.
March 5	„	About 1ᵐ increasing to full brightness.
1870. Feb. 1	—	Neither observer satisfied.
9	N. R. P.	Faded away slowly for nearly 2ᵐ, and uncertain to about 10ˢ.
	J. P. B.	Uncertain to 5ˢ.
20	G. W. B.	Uncertain to about 17ˢ.
1871. Jan. 5	N. R. P.	Faint and slowly increasing for a minute or more.
21	„	Increasing through full 6ᵐ; uncertain to 10ˢ.
27	„	Full brilliancy of second satellite acquired in less than 3ᵐ after reappearance.
	N E. P.	First satellite about 3ᵐ entering on disk.
	N. R. P.	Uncertain to about 30ˢ.

Date.	Observer.	Notes.
1871.		
Jan. 27	N. E. P.	Shadow immersion of first satellite: first and last contacts differed by $2^m\ 38^s$.
	N. R. P.	Uncertain to about 30^s.
	N. E. P.	Transit emersion of first satellite: first and last contacts differed by $2^m\ 45^s$.
28	N. R. P.	First contact and last disappearance differed by 52^s.
30	,,	Fading away for full 6^m before.
Feb. 6	,,	Uncertain to about 30^s.
1874		
Jan. 29	N. R. P.	Fading visibly for about $2^m\ 30^s$, and uncertain to about 3^s.
	E. I. P.	Uncertain to 2 or 3 seconds.
1875.		
April 7	N. R. P.	Transit emersion of first satellite: satellite sharp and white on large north belt.
13	E. I. P.	Transit immersion of second satellite: completely on disk $1^m\ 57^s$ after.
	,,	Shadow emersion of second satellite: completely gone $1^m\ 35^s$ later.
15	N. R. P.	First satellite fading away for about $1^m\ 30^s$ before disappearance.
	,,	First satellite clear of the disk 58^s after first reappearance.
27	,,	At least 6^m in acquiring its full light.
29	,,	About 3^m increasing to full brightness.
May 4	,,	Third satellite increasing for 9^m after reappearance.
6	,,	About 4^m increasing to full brightness.
8	E. I. P.	About 3^m ,, ,,
11	,,	Third satellite quite out a little over 4^m later.
	N. R. P.	,, ,, ,,
15	E. I. P.	Transit egress of second satellite: first seen $3^m\ 31^s$ before.
	N. R. P.	Increasing for 3^m or 4^m.
22	E. I. P.	Completely on disk $1^m\ 45^s$ later.
23	N. R. P.	Completely gone $1^m\ 30^s$ later.
1876.		
May 24	,,	Well out when first seen: 1^m increasing.
25	E. I. P.	First contact and complete disappearance of third satellite differed by $14^m\ 5^s$.
	N. R. P.	The interval between the first contact and the complete disappearance of the third satellite was $16^m\ 19^s$.
	,,	Reappearance of third satellite: equal to fourth at $10^h\ 42^m\ 14^s$, and of full brightness at $10^h\ 46^m\ 43^s$.
26	E. I. P.	Increasing for about 4^m.
27	,,	First and last contacts differed by $2^m\ 12^s$.

Date.	Observer.	Notes.
1876.		
June 11	N. R. P.	Increasing for about 3^m.
Aug. 3	E. I. P.	Second satellite fading for about 5^m.
	N. R. P.	Second satellite reappeared from occultation 2^m or 3^m earlier.
1878.		
Sept. 19	E. I. P.	First and last contacts at disappearance of first satellite differed by 2^m 40^s.
	N. R. P.	First and last contacts at disappearance of first satellite differed by 6^m 58^s. Sky hazy and definition bad.
	,,	First satellite increasing for about 2^m 30^s after reappearance.
21	E. I. P.	Increasing for about 3^m.
28	,,	Increasing for about 2^m 30^s.
Oct. 1	,,	,, 1^m 30^s.
14	,,	Sky very hazy.
21	E. I. P.	First and last contacts differed by 7^m 55^s.
	N. R. P.	,, ,, 6^m.
1880.		
Dec. 13	S. B. H.	First satellite last seen. Passing clouds about.
	,,	Increasing for about 2^m 30^s.
	E. I. P.	,, ,,
1881.		
Feb. 5	E. I. P.	*Jupiter* too low for further observation.

Most of the observations were made by the Astronomer and various members of his family, and a few by friendly amateurs, who, being present at the time, kindly lent their assistance.

The observations, mostly recorded with sidereal clocks, have been reduced to Madras mean time, and the *Nautical Almanac* times of the various phenomena added in a separate column to show the difference between observation and theory. The small letters, *b* for beginning or first contact, *m* for middle or bisection, and *e* for end or last contact, have been used to signify the phase noted.

The instruments used were the eight-and-a-half inch Equatoreal by Messrs. Troughton & Simms; the six-and-a-quarter inch Equatoreal by Messrs. Lerebours & Secretan; and the excellent five-foot telescope by Tulley, originally constructed for Captain W. H. Smyth, R.N., in 1829, afterwards the property of J. Lee, Esq., LL.D. of Hartwell, and known as the Smythian Telescope. The magnifying powers employed are also given.

The names of the observers, indicated by their initials, were:—

Norman Robert Pogson, Esq., C.I.E., Government Astronomer.

Norman Everard Pogson, late Assistant Government Astronomer.

Elizabeth Isis Pogson, present Assistant Government Astronomer.

Charles Albion Pogson, an intelligent little boy of ten, who could record the clock very correctly.

Captain James Palladio Basevi, R.E., of the Great Trigonometrical Survey of India.

George W. Barclay, Esq., Assistant-Superintendent, Government Telegraph Department, in charge of Madras Office.

Robert Fellowes Chisholm, Esq., F.R.I.B.A., Consulting Architect to Government, Madras.

Major Bertie B. Hobart, R.A., Military Secretary to the Governor of Madras.

Surgeon-Major Samuel Bradshaw Hunt, Indian Medical Department.

The reductions of occultations of planets and stars, and of other casual phenomena observed at Madras since 1861, are in hand, and will follow shortly.

Madras Observatory:
1881, *June* 9.

Observations of Jupiter's Satellites made at the Stonyhurst Observatory. By the Rev. S. J. Perry.

		Satellite.	Phenomenon.	G.M.T. h m s	In excess of N.A.	Observer.	Remarks.
1881, Jan.	6	II.	Ec. R. First seen	9 53 14·2	−0 31·88	S. J. P.	Definition very bad, wind very high. Full brilliancy.
			Full light	58 37·7		,,	$\frac{4}{5}$ of III.
	19	I.	Ec. R. First seen	9 32 2·4	+0 15·4	,,	Good passing clouds.
			Full light	33 59·7		,,	
	31	II.	Ec. R. First seen	7 3 29·0	−0 42·0	,,	Very good. Auroral clouds.
			Full light	5 11·3		,,	
Feb.	8	III.	Ec. R. First seen	6 11 13·0	−5 17·0	W. C.	Very good.
			Full light	16 32 8		,,	
	11	I.	Oc. D. Ext. cont.	6 26 49 5		,,	Good. Thin clouds passing.
			Bisection	28 42·0		,,	
			Last seen	30 53·5		,,	
July	20	I.	Ec. D. Light fading	14 31 22·5		,,	Very good. Dark screen in eyepiece.
			Last seen	37 45·3	+1 41·3	,,	
Sept.	14	I.	Tr. I. First cont.	9 45 23·2		,,	Poor. Very unsteady
			Bisection	46 24·8		,,	
			Int. cont.	49 44·4		,,	
	19	II.	Oc. R. First seen	10 35 54·5		S. J. P.	Definition fair.
			Bisection	37 53·3		,,	
			Last cont.	39 47·9		,,	

	Satellite.	Phenomenon.	G.M.T. h m s	In excess of N.A.	Observer.	Remarks.
1881, Oct. 8	I.	Oc. R. Bisection	8 59 58·3		W. C.	
		Last cont.	9 2 6·8		,,	Good. Dancing slightly.
14	I.	Tr. I. Ext. cont.	11 19 28·7		,,	Good, but unsteady.
		Bisection.	24 6·4		,,	
		Int. cont.	27 18·8		,,	
15	I.	Ec. D. Fading	7 50 32·0		,,	
		Half brilliancy	51 29·0		,,	Very good. Definition rather poor.
		Last seen	52 5·5	+0 32·5	,,	
	I.	Oc. R. Bisection	10 42 52·2		,,	
		Ext. cont.	45 40·0		,,	Very good. Definition excellent.
16	I.	Sh. E. Int. cont.	7 18 16·2		,,	
		Bisection	19 58·7		,,	Observation only fair. Shadow very small. Definition poor and unsteady.
		Last cont.	20 53·9		,,	
	I.	Tr. E. Int. cont.	7 55 21·4		S. J. P.	
		Bisection	58 37·7		,,	Limb unsteady. Definition good.
		Ext. cont.	8 1 37·9		,,	
17	II.	Ec. D. Fading	16 3 57·2		W. C.	
		Half brilliancy	5 25·7		,,	Very good. Dark screen used.
		Last seen	7 29·0	+0 21·0	,,	

	Satellite.	Phenomenon.	G.M.T. h m s	In excess of N.A.	Observer.	Remarks.
1881, Oct. 29	I.	Ec. D. Fading	11 38 44·4		W. C.	Very good. Dark screen used.
		Half brilliancy	39 5·2		,,	
		Last seen	40 49·2		,,	
	I.	Oc. R. First seen	14 12 23·1		,,	Very good. Dark screen used.
		Bisection	13 12·9		,,	
		Ext. cont.	14 14·7		,,	
30	I.	Sh. I. Bisection	9 1 35·3		,,	Good. Sh. exceedingly small, but black.
		Int. cont.	3 33·8		,,	
	I.	Tr. I. Ext. cont.	9 16 44·0		,,	Very good. Definition excellent.
		Bisection	18 37·2		,,	
		Int. cont.	21 3·3		,,	
Nov. 20	II.	Tr. I. Ext. cont.	9 33 27·6		J. R.	Good.
		Bisection	37 11·2		,,	
		Int. cont.	42 3·8		,,	
	II.	Sh. I. Int. cont.	10 9 20·6		W. C.	
	II.	Tr. E. Int. cont.	12 9 36·9		J. R.	Thin clouds over planet at times. Light much diminished, but definition good.
		Bisection	12 37·4		,	
		Ext. cont.	16 42·9		,,	
22	II.	Ec. R. First seen	7 33 4·7	−0 36·3	S. J. P.	Good. *About $\frac{3}{5}$ of Sat. I.
		Half brilliancy	35 25·0		,,	
		Full brilliancy*	36 44·5		,,	

	Satellite.	Phenomenon.	G.M.T. h m s	In excess of N.A.	Observer.	Remarks.
1881, Nov. 22	I.	Tr. I. Ext. cont.	8 51 26·5		S. J. P.	Definition rather poor. Sat. well seen on disk, but not on band.
		Bisection	55 51·3		,,	
		Int. cont.	58 6·7		,,	
	I.	Sh. I. Bisection	9 15 50·8		,,	Shadow not very black. Definition rather poor.
		Full on	17 11·7		,,	
25	III.	Tr. I. First cont.	9 51 42·1		W. C.	Sky hazy, but definition good.
		Bisection	58 7·7		,,	
		Int. cont.	10 6 42·5		,,	
29	II.	Oc. D. Ext. cont.	6 40 56·0		S. J. P.	Hazy. Definition poor.
		Bisection	44 0·0		,,	
		Int. cont.	46 6·2		,,	
	II.	Ec. R. First seen	10 8 18·2	−0 42·8	,,	Very good observation. Definition very good.
		Half brilliancy	10 4·5		,,	
		Full brilliancy	11 45·8		,,	
	I.	Tr. I. Ext. cont.	10 38 46·0		,,	Excellent. Very bright on disk.
		Bisection	41 1·3		,,	
		Int. cont.	43 20·6		,,	
	I.	Sh. I. First seen	11 6 12·4		,,	Sh. very large and black. Very good observation.
		Bisection	7 5·7		,,	
		Full on	2 31·8		,,	

	Satellite.	Phenomenon.	G.M.T. h m s	In excess of N.A.	Observer.	Remarks.
1881, Nov. 29	I.	Tr. E. Bisection	12 51 55·9		S. J. P.	Sky hazy.
		Ext. cont.	53 49·3		,,	
Dec. 1	I.	Tr. I. First cont.	5 2 2·9		J. R.	Definition good.
		Bisection	5 17·4		,,	
		Int. cont.	10 24·1		,,	
		Sh. I. Bisection	5 35 1·4		S. J. P.	Definition good. Observation fair. Few thin clouds.
		Full on	37 39·9		,,	
	I.	Tr. E. Int. cont.	7 10 40·6		,,	Thin clouds passing.
		Bisection	14 17·8		,,	
		Ext. cont.	17 6·3		,,	
13	III.	Oc. R. First seen	7 30 13·6		,,	Definition good. Sky rather misty.
		Bisection	33 32·9		,,	
		Ext. cont.	38 1·2		,,	
	III.	Ec. D. Fading	9 3 52·5		,,	Definition good.
		Half brilliancy	6 59·9		,,	
		Last seen	13 5·1	+4 1·0	,,	
	III.	Ec. R. First seen	10 36 8·7	−7 29·3	,,	Definition good.
		Half brilliancy	40 27·3		,,	
		Full light	42 24·5		,,	

	Satellite.	Phenomenon.	G.M.T. h m s	In excess of N.A.	Observer.	Remarks.
1881, Dec. 13	II.	Oc. D. First cont.	11 11 16·5		W. C.	
		Bisection	13 47·5		,,	Definition good.
		Last seen	18 12·5		,,	
14	I.	Oc. D. Ext. cont.	11 17 52·9		J. R.	
		Bisection	21 39·6		,,	Definition good.
		Last seen	23 45·4		,,	
	I.	Ec. R. First seen	14 17 16·6	−0 3·4	,,	Definition good. Sky rather misty.
		Full brilliancy	20 45·1		,,	
22	II.	Tr. I. First cont.	8 1 0·5		,,	
		Bisection	2 51·2		,,	Very good.
		Int. cont.	4 32·0		,,	
	I.	Tr. I. First cont.	10 24 6·2		J. R.	
		Bisection	25 53·9		,,	Very good.
		Int. cont.	27 32·7		,,	

Occultations of Stars by the Moon, seen at the Stonyhurst Observatory. By the Rev. S. J. Perry.

		Phenomenon.	Moon's Limb.	G.M.T.	Observer.	Remarks.
1881, Feb.	11	Disapp. 3 Cancri	Dark	7 52 47·5	W. C.	Very good. Dark screen in eyepiece.
		Reapp. ,,	Bright	9 8 4·2	,,	Excellent. ,, ,,
May	4	Disapp. 5 Cancri	Dark	9 12 59·84	,,	Very faint, but very good. Dark screen in eyepiece.
		Reapp. ,,	Bright	10 16 45·18	,,	,, ,, ,,
July	19	Disapp. δ Arietis	,,	12 30 4·40	,,	Thin clouds. Good. Dark screen in eyepiece.
		Reapp. ,,	Dark	13 11 59·70	,,	Excellent.
Sept.	14	Disapp. *n* Tauri	Bright	11 35 9·70	,,	Very good.
		Reapp. ,,	Dark	12 10 21·80	,,	,, Haze round the Moon
Oct.	14	Disapp. *f* Geminorum	Bright	13 9 58·90	,,	Excellent.
		Reapp. ,,	Dark	13 54 57·70	,,	,,
	15	Disapp. 29 Cancri	Bright	13 43 21·60	,,	,,
		Reapp. ,,	Dark	14 53 38·20	,,	,,
	17	Disapp. 14 Sextantis	Bright	17 59 15·20	,,	Very good.
Nov.	29	Disapp. 19 Piscium	Dark	11 24 7·70	S. J. P.	,,

Computed and Observed Times of Contacts of the Transit of Mercury at Castlemaine, Victoria, Lat. 37° 4′ 11″ *S.; Long.* 9^h 36^m 55^s *E.* By W. Bone, Esq. M.D.

(*Communicated by the Secretaries.*)

First External Contact. Local mean time.

	h	m	s		h	m	s
Computed,	19	53	18·6	Observed,	19	53	54·32.

First Internal Contact.

Computed,	19	55	1·4	Observed,	19	55	36·92.

Second Internal Contact.

Computed,	1	12	36·7	Observed,	1	12	36·5.

Second External Contact.

Computed,	1	14	19·4	Observed,	1	14	8·8.

Taken with 4·7-inch (Wray) Equatoreal. Power used, 200. Barometer, 29·25 (1,000 feet above sea); Thermometer, shade, 71° F.

Beading very noticeable at ingress. Observation taken for mean of beading, which was about 4^s: less noticeable at egress. The time of first external contact was most carefully noted, but shows a large difference from computed time. Sky clear at each observation.

The Satellites of Mars. By John Watson, Esq.

The evening of December 22, 1881, was very clear, and having seen from Mr. Marth's Ephemeris that both the satellites of *Mars* were favourably situated, I began at 7 P.M. to map the small stars in the neighbourhood of the planet as seen with my 12-inch Cooke Achromatic mounted equatoreally in the open air. I found a power of 235 to be as good as any, and by simply hiding the planet behind the sharply-defined edge of the diaphragm of a fine Huyghenian eyepiece, the more remote *Deimos* was seen following the planet at 8 P.M., and distant about two and a half diameters of *Mars* from the edge of the primary.

Various powers were tried up to 700 (with which this instrument works well at times), but the state of the atmosphere was such that no advantage was gained by increase of power above 235. At 8^h 40^m I saw *Phobos* for the first time preceding the planet, and distant, by careful estimate, one diameter of *Mars* from the edge of the planet's disk. Later in the evening the atmosphere turned hazy.

I send this communication because very few observations of these objects are recorded in this county, and it was a matter of interest to have watched them alternately on opposite sides of the planet, and without any special contrivance.

Vane House, Seaham Harbour:
1882, *January* 4.

Errata.

Vol. xlii. p. 40, *for* July 29 *read* July 31.
Vol. xlii. p. 52, heading of fourth column, *for* Parallactic Inequality apparently corrected, *read* Parallactic Inequality approximately corrected.
Also, in the fourth column of the table upon the same page,

opposite group	1834–1842	*for*	125·11	*read*	123·88
„	1839–1847	„	123·88	„	123·67
„	1843–1851	„	123·67	„	125·26
	1847–1851	„	125·26	„	126·42